Accelerated Bridge Construction (ABC) – National Status

by

Mary Lou Ralls, P.E., Ralls Newman, LLC

88th Annual Transportation Short Course
Texas A&M University – College Station, Texas
Session: Construction I
October 14, 2014
Presentation Outline

• Introduction
• Types of Prefabricated Bridge Elements & Systems (PBES) for ABC
• ABC Case Studies
• ABC in Texas
• Resources
Accelerated Bridge Construction (ABC) – Vision

replacement or new bridge construction that uses innovative design & construction methods & high performance materials to reduce the typical length of time of onsite bridge construction without reducing the quality, in order to open a cost-effective long-lasting bridge to traffic with increased safety & reduced traffic disruption in a shortened onsite construction period.
Accelerated Bridge Construction (ABC) - Definition

- Bridge construction that uses innovations to reduce onsite construction time
- Innovations in:
  - Planning
  - Design
  - Materials
  - Construction
ABC Innovation Examples

• **Planning**
  – Early environmental clearance / permitting
  – Innovative contracting strategies in contract documents (e.g., A+B bidding, lane rental, I/D)

• **Design**
  – Prefabrication with bridge elements (e.g., modular decked beams, precast substructures)
  – Entire superstructure installations (e.g., self-propelled modular transporter moves, lateral slides)
ABC Innovation Examples

• **Materials**
  – High-performance concrete (HPC) or steel (HPS)
  – Lightweight materials, e.g., concrete, backfill

• **Construction**
  – Use of innovative equipment (e.g., self-propelled modular transporters to move entire bridge)
  – Use of innovative scheduling (e.g., building substructure prior to bridge closure)
ABC Time

Onsite construction time:
When contractor alters the project site, until all construction-related activity is removed

Mobility impact time:
When traffic flow of transportation network is reduced due to onsite construction activities
Mobility Impact Time

Traffic impacts within:

Tier 1: 24 hours
Tier 2: 3 days
Tier 3: 2 weeks
Tier 4: 3 months
Tier 5: > 3 months but overall project schedule significantly reduced
Reasons for Using ABC

- reduced traffic impacts
- reduced onsite construction time
- improved work-zone safety
- improved site constructability
- improved material quality and product durability
- minimized environmental impacts
- reduced life-cycle cost
Presentation Outline

• Introduction

➢ Types of Prefabricated Bridge Elements & Systems (PBES) for ABC

• ABC Case Studies

• ABC in Texas

• Resources
Prefabricated Bridge Elements & Systems (PBES)

- One type of ABC
- Built:
  - Offsite, or
  - Adjacent to alignment
- Include features that reduce:
  - Onsite construction time
  - Mobility impact time
Prefabricated Deck Elements

Examples:
- Partial-depth precast deck panels
- Full-depth precast deck panels
- FRP deck panels
- Steel grid decks (open or filled)
Prefabricated Beam Elements

Examples of Deck Beam Elements:
- Modular decked beams
- Adjacent decked bulb-tee beams
- Adjacent double tee beams
- Adjacent box beams
- Adjacent slab beams
- PT concrete through-girder
Modular Decked Beams
(steel beam with concrete deck)

2011 MA
Salem St Bridge EB
(93FAST14)

2011 MA
River Road Bridge
in town of Uxbridge
Modular Decked Beams
(concrete beam with concrete deck)

Northeast Extreme Tee (NEXT) Beam *

2011 VT Chester VT 103 Bridge 8

* http://www.pcine.org/index.cfm/resources/bridge/Northeast_Extreme_Tee_Beam
Prefabricated Beam Elements

Examples of Full-Width Beam Elements:
- Truss span without deck
- Arch span without deck
- Precast segmental
- Steel segmental
Prefabricated Pier Elements

Examples:
-Prefab caisson caps
-Prefab pile cap – steel or precast
-Prefab columns and/or caps – steel or precast
-Precast footings
Prefabricated Abutment & Wall Elements

Examples:
- Precast caps, backwalls, wingwalls, footings
- Sheet piling – steel or precast
- Precast full-height wall panels
- MSE walls
- GRS abutments
Prefabricated Miscellaneous Elements

Examples:

- Precast approach slabs
- Prefab parapets
- Closure pours
- Overlays
Prefabricated Bridge Elements Currently of Most Interest Nationally

➤ Modular Decked Beams

Steel

Concrete
Prefabricated Bridge Systems

Systems: rolled, launched, slid, etc.
- Superstructure
- Superstructure/pier
- Total bridge
Prefabricated Bridge Systems
Currently of Most Interest Nationally

- Superstructure span moves using self-propelled modular transporters
- Superstructure span lateral slides using hydraulic jacks

- Concrete beams; single-span move
- Steel beams; 2-span move
- Steel beams; 3-span slide
- Concrete beams; 5-span slide

FHWA Every Day Counts
Presentation Outline

• Introduction
• Types of Prefabricated Bridge Elements & Systems (PBES) for ABC
  ➢ ABC Case Studies
• ABC in Texas
• Resources
ELEMENTS Case Study 1: 2011 VT Chester VT 103 Bridge 8

- Bridge 8
- Bridge 9

- 1 of 2 single-span bridges in design-bid-build project on rural road
- 3-week closure
Elements Case Study 1: 2011 VT Chester VT 103 Bridge 8

Primary reasons for use of ABC:

• Reduced traffic impacts – 7,200 ADT
• Reduced onsite construction time
• Improved work-zone safety
• Minimized environmental impacts
Elements Case Study 1: 2011 VT
Chester VT 103 Bridge 8

Precast:
• Abutments
• Beams
• Approach slabs
Elements Case Study 1: 2011 VT Chester VT 103 Bridge 8

- PCINE NEXT 28D beam (decked double tee)
- 8-inch-wide longitudinal deck joints
Elements Case Study 1: 2011 VT Chester VT 103 Bridge 8

Other ABC included:
• Full lane closure
• Incentives/disincentives
• Lump sum bonus
• Value engineering
• Asphalt overlay w/membrane

3-week closure
Elements Case Study 2: 2011 MA Salem St Bridge EB (93FAST14)

- 3-span bridge on I-93 through City of Medford
- Modular decked beams
- 1 weekend closure
- Design-build project
- 10 weeks for 14 bridges
- Total 41 spans
Primary reasons for use of ABC:
- Reduced traffic impacts – 181k ADT
- Reduced onsite construction time
- Improved site constructability
Elements Case Study 2: 2011 MA Salem Street Bridge EB (93FAST14)

- Abutments & interior supports repaired prior to closure
Elements Case Study 2: 2011 MA Salem Street Bridge EB (93FAST14)

- 6 modular decked steel beams per span
- 2.67-ft-wide longitudinal deck joints
- Link slabs over interior supports
Elements Case Study 2: 2011 MA
Salem Street Bridge EB (93FAST14)

Other ABC included:
- State decision-making process
- Early environmental clearance
- Electronic submittal/approval
- Full lane closure
- Warranties
- Incentives/disincentives
- No excuse bonus
- Value engineering
- Asphalt overlay w/membrane

I-93 SB detoured Friday at 8 pm
Fully re-opened Monday at 5 am
SYSTEMS Case Study 1: 2011 MA Cedar Street Bridge – Wellesley

- 2-span superstructure roll-in with SPMTs*
- 530-ton self weight
- Design-build project
- Urban location
- Weekend closure

* SPMTs = self-propelled modular transporters
Systems Case Study 1: 2011 MA Cedar Street Bridge – Wellesley

Primary reasons for use of ABC:

- Reduced traffic impacts – 39K ADT
- Reduced onsite construction time
- Improved work-zone safety
- Improved site constructability
- Improved material quality & product durability

Completed bridge

83 ft long & 53 ft wide (41.5 ft – 41.5 ft)
Systems Case Study 1: 2011 MA Cedar Street Bridge – Wellesley

Precast Elements:
- Abutment caps
- Pier cap
- Approach slabs

System:
- 2-Span Superstructure
Systems Case Study 1: 2011 MA Cedar Street Bridge – Wellesley

Conventional construction adjacent to bridge site

- W14x159 steel girders @ 6.75-ft spacing
- 8-inch-thick composite cast-in-place concrete deck w/ 3-inch-thick hot-mix asphalt (HMA) wearing surface
Systems Case Study 1: 2011 MA Cedar Street Bridge – Wellesley

Demolish bridge; repair existing substructure; install precast caps
Systems Case Study 1: 2011 MA Cedar Street Bridge – Wellesley

Move 2-span superstructure on SPMTs
Systems Case Study 1: 2011 MA Cedar Street Bridge – Wellesley

Other ABC included:

- State decision-making process
- Electronic shop dwg. submittal & approval
- Full lane closure
- Incentive/disincentive
- Lump sum bonus
- Asphalt overlay w/membrane
- High capacity cranes

Closed Friday at 10 pm
Re-opened Monday at 12 noon
Systems Case Study 2: 2008 OR Ek Creek Bridge (Crossing No. 4)

- 2-span superstructure lateral slide
- Design-build project
- Rural location
- Weekend closure of Oregon Route 38
Primary reasons for use of ABC:

- Reduced traffic impacts – 3,900 ADT
- Reduced onsite construction time
- Improved work-zone safety
- Improved site constructability
- Improved material quality & product durability
- Minimized environmental impacts
Systems Case Study 2: 2008 OR Elk Creek Bridge (Crossing No. 4)

222-ft long & 38-ft wide (160 ft – 62 ft)

Conventional superstructure constructed adjacent to bridge site; Cast-in-place substructure constructed under traffic
Systems Case Study 2: 2008 OR Elk Creek Bridge (Crossing No. 4)

Precast:
Bulb-tee beams
Wingwalls – 1 side
Approach Slabs
Sleeper Slabs
Systems Case Study 2: 2008 OR Elk Creek Bridge (Crossing No. 4)

Other ABC included:

- State decision-making process
- Early environmental clearance/permitting
- Full lane closure
- Incentive / disincentive clauses

Bridge in final location

OR 38 closed Friday at 8 pm
OR 38 re-opened Monday at 5 am
Presentation Outline

• Introduction
• Types of Prefabricated Bridge Elements & Systems (PBES) for ABC
• ABC Case Studies
  ➢ ABC in Texas
• Resources
Texas partial-depth deck panels
Typical Transverse Section
(2nd generation)

Panel Length (PL) = GS + OH - 6"

K required in Interior Panel.

G required in End Panel and A required in Interior Panel.

T required in End Panel and Interior Panel.

8 1/4" Leveling Bolt Pad

6" Chamfer

3/4" Continuous Drip Bead

1 1/4" Girder

3/8" Girder

8 1/4" Continuous Drip Bead

1" Girder

Panel Length (PL) = GS + OH - 6"

F required in End Panel and Interior Panel. Showing F bar field bent.

1" Dia Coil Rod or 1" Dia Coil Bolt shown, are furnished by the contractor. (Typ)

Place Leveling Bolt Pad flush with bottom of panel. (Typ)

See PCP standard.

Girder Spacing (GS) See Span sheets

Overhang (OH) See Span sheets

Ref.: TxDOT Bridge Division
End Precast Overhang Panel

Ref.: TxDOT Bridge Division
Interior Precast Overhang Panel
2008 TX
Live Oak Creek Bridge

Erection of deck panels over shear studs on beams

86 full-depth, full-width deck panels, totaling 22,400 sq ft

Precast panels provided quality deck for this bridge with limited access to batch plants (75 miles from nearest plant)
1997 TX
I-45 Pierce Elevated Bridge

226 spans with prefabricated bent caps & partial-depth deck panels
Texas – Precast Reinforced Concrete Bent Caps

• SH 66/ Lake Ray Hubbard (2002) – Contractor request for precast caps to reduce work near power lines over water
• SH 36/ Lake Belton (2003) – Precast bent caps used for speed, safety, quality, and cost
TxDOT Precast Prestressed Concrete Bent Caps
LP 1604, Bexar County – San Antonio

18 caps for NB Bridge placed in 3 days
US59 under Dunlavy, Hazard, Mandel & Woodhead Sts
Prefabricated steel tied arches reduce traffic disruptions to US 59 due to construction and accommodate minimum vertical clearance requirement
Precast pre-topped U-Beams were erected near site, then top slab & outside curbs were cast. 104 pre-topped pretensioned concrete Type PTU-34 beams were used. Longitudinal & transverse closure joints were constructed after beams were erected in final location.
Precast column shells were cast near site and quickly erected onsite.

4 four-span bridges over I-35, each span 115 ft long; total superstructure depth = 38 inches.

Final structure

Minimized impact to I-35 traffic (1-2 spans erected per night in the only I-35 closures)
Proposed ABC Policy

• Will ask District if they want to investigate ABC for their bridge project
• If so, will use an ABC Analytic Hierarchy Process (AHP) tool to evaluate the project to determine if ABC is appropriate for the site
• Tools are being put into place to use and will require modest amount of input from the District

Ref.: TxDOT Bridge Division
Presentation Outline

• Introduction
• Types of Prefabricated Bridge Elements & Systems (PBES) for ABC
• ABC Case Studies
• ABC in Texas

➢ Resources
FHWA ABC Website
http://www.fhwa.dot.gov/bridge/abc

Accelerated Bridge Construction

- Project Planning
- Geotechnical Solutions
  - Foundations and Wall Elements
  - Rapid Embankment Construction
- Structural Solutions
  - Prefabricated Elements & Systems
  - Structural Placement Methods

What is ABC?

ABC is a paradigm shift in the project planning and procurement approach where the need to minimize mobility impacts which occur due to onsite construction activities are elevated to a higher priority.

Intrinsic benefits of the ABC approach include improvements in:
FHWA Every Day Counts-3 Website
http://www fhwa dot gov/ everydaycounts/ summits/ edc-3.cfm

EDC-3: "Efficiency Through Technology and Collaboration"

Innovation Sessions at the Regional Summits

EDC is a state-based model to identify and rapidly deploy proven, but underutilized innovations to shorten the project delivery process, enhance roadway safety, reduce congestion and improve environmental sustainability. The seven Regional Summits scheduled this fall will set the stage for deployment of 11 innovations through the third 2-year cycle of EDC (EDC-3) in 2015 and 2016.

The objective of the Regional Summits is to facilitate dialogue, encourage creative thinking and celebrate a shared vision for new opportunities. These Regional Summits are an integral component of the EDC model, bringing together transportation leaders and front-line professionals responsible for development and delivery of highway projects. These Summits provide the transportation professionals the opportunity to learn about the 11 innovations promoted through EDC-3, exchange ideas with their agency and industry counterparts in neighboring States, and provide feedback to FHWA on the support and resources needed to adopt the innovations in their own
FHWA EDC-3 Website
http://www.fhwa.dot.gov/everydaycounts/summits/edc-3.cfm

Innovation Sessions at EDC-3 Regional Summits
– broadcast live –

Ultra-High Performance Concrete Connections for Prefabricated Bridge Elements:

• October 23, 2014: 3:15–5:00 pm CT
• October 30, 2014: 10:00–11:45 am CT

Register online
FHWA EDC-3 Website
http://www.fhwa.dot.gov/everydaycounts/summits/edc-3.cfm

Innovation Sessions at EDC-3 Regional Summits
– broadcast live –

Geosynthetic Reinforced Soil
– Integrated Bridge System (GRS-IBS):

• October 23, 2014: 1:00–2:45 pm CT
• October 29, 2014: 3:00–4:45 pm CT

Register online
FHWA EDC-3 Website
http://www.fhwa.dot.gov/everydaycounts/summits/edc-3.cfm

Innovation Sessions at EDC-3 Regional Summits
– broadcast live –

- 3D Engineered Models
- Improving Collaboration & Quality Environmental Documentation
- Improving DOT & Railroad Coordination
- Smarter Work Zones

Register online
Accelerated Bridge Construction
University Transportation Center (ABC-UTC)

http://www.abc-utc.fiu.edu
ABC-UTC Upcoming Events

• Free monthly webinars – Thurs., Oct. 16
  – “Accelerated Bridge Construction in Pennsylvania”
• In-depth web training – Tues., Nov. 4
  – “MassDOT I-93 Fast14 Project”
• National ABC Conference – Dec. 4-5
  – Miami, FL
  – Pre-conference Workshops – Dec. 3
  – Registration Deadline: November 21

ABC-UTC website: www.abc-utc.fiu.edu
Thank You